

Comparison of Endovascular and Surgical Treatment for Ruptured Cerebral Aneurysms with respect to Short and Long-Term Outcome

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Summary

We compared the treatment for ruptured aneurysms from the clinical and radiological follow-ups after endovascular (GDC) or surgical treatment. There were 142 surgically treated cases and 38 endovascular treated cases from May 1997 to December 2001. In endovascular cases there were four A-com, four MCA, 12 ICA and 18 posterior circulation aneurysms. In surgical cases, there were 53 A-com ACA, 51 MCA, 36 ICA and two posterior circulation aneurysms. The clinical outcomes of endovascular and surgical treatments were correlated with the H & H grades before treatments. At short stage, 71% of endovascular and 78.2% of surgical cases showed a favorable outcome (GOS GR or MD) ($p = 0.3$). Long-term clinical follow ups (14.5 to 58 months) showed 77.7% of endovascular and 87.7% of surgical cases resulted in GR or MD ($p = 0.17$).

In endovascular cases, 22.2% showed recurrence during the follow-up period and five of them needed re-treatment. We experienced failed endovascular approach at acute stage in seven cases which changed to surgery. In conclusion, the short and long term clinical results of endovascular treatment were acceptable comparing surgical clipping. High recurrence rate after GDC treatment did not permit future completeness of the treatment. Still the treatment alterna-

tive between endovascular or surgical treatment may change depending on the criteria of each institution, attention should be paid to the disadvantages of endovascular treatment as the first choice for ruptured aneurysms.

Introduction

Endovascular treatment using Guglielmi Detachable Coil (GDC) for cerebral aneurysms was widely accepted and clinical results are excellent compared with surgical clipping^{1,2}. However, considering unclear long-term results and unsuccessful attempts^{3,4}, it is difficult to select treatment between GDC embolization or surgical clipping for acutely ruptured cerebral aneurysm.

We discuss the selection of treatment between endovascular treatment and surgery for ruptured cerebral aneurysm from the assessment of clinical and radiological results also with technical problem of endovascular treatment.

Patients and Method

There were 180 aneurysm cases, of them 142 were treated with surgery and 38 cases were treated with endovascular treatment using GDC. Selection of the treatment was decided considering the anatomical situation of the

aneurysm and clinical condition of the patient (table 1).

Patients' ages were 25 to 84 (58.6 ± 15.4) years in endovascular cases and 24 to 78 (56.2 ± 11.7) years in surgical cases. There were 16 males and 22 females in endovascular cases, and 54 males and 88 females in surgical cases (table 1).

Preoperative Hunt and Hess grade were as follows. In endovascular cases, grade I was seven, II was 14, III was eight, IV was eight and V was one. In surgical cases, grade I was 13, II was 57, III was 42, IV was 27 and V was three (table 1).

Surgical cases included seven unsuccessful endovascular attempted cases. The reasons for unsuccessful GDC treatment were two thromboembolic complications, two too small size for coiling, one incomplete packing, one coil penetration and one difficulty in catheterization.

In endovascular cases, 21 cases were treated in acute stage (within 72 hours), eight cases were treated in subacute stage (4 to 14 days) and nine cases were treated in chronic stage. In surgical cases, 125 cases were treated in acute stage, ten cases were treated in subacute stage and seven cases were treated in chronic stage (table 1).

In endovascular cases there were four A-com, four MCA, 12 ICA and 18 posterior circulation aneurysms. In surgical cases, there were 53 A-com ACA, 51 MCA, 36 ICA and two posterior circulation aneurysms. Rate of posterior circulation aneurysm was 1.4% in surgical cases and 47.4% in endovascular cases. There were five vertebral dissecting aneurysms treated with GDC by parent artery occlusion with aneurysm packing (table 1).

Assessment of clinical outcome was performed using Glasgow outcome scale at the time of discharge (short stage) and after long term follow ups. Angiographic follow-ups were done during first treatment in endovascular and surgical cases to detect the residual aneurysm. The long-term radiological follow-ups were performed only in endovascular cases by cerebral angiography at six months, one, two and three years. Comparisons of GOS score were performed using Chi-squared test.

Results

Immediate Clinical Results

The clinical outcomes of endovascular and surgical treatments were correlated with the H&H grades before treatments. At short stage

Table 1

		Endovascular	Surgery
	Case number	38	142
	Age	58.6 ± 15.4	56.2 ± 11.7
	Male	16	54
	Female	22	88
Location	ICA	12	36
	ACA	4	53
	MCA	4	51
	Posterior circulation	18	2
H&H grade	I	7	13
	II	14	57
	III	8	42
	IV	8	27
	V	1	3
Timing of the treatment	Acute (< 72hrs)	21	125
	Subacute (4 ~ 14 days)	8	10
	Chronic (> 15 days)	9	7

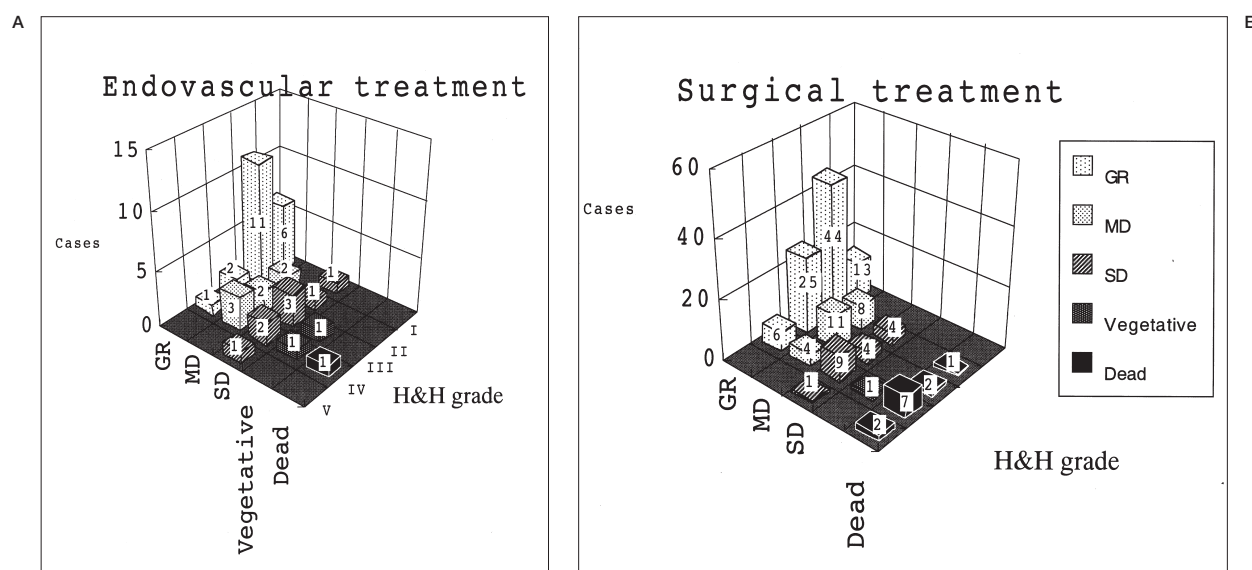


Figure 1

after the treatment (four to eight weeks), 71% of endovascular and 78.2% of surgical cases showed a favorable outcome ($p = 0.3$). In H&H grade I or II cases, GR or MD cases were seen in 90% of endovascular and 93% of surgical cases ($p = 0.72$). The death of acute stage is 2.6% in GDC and 8.6% in surgical cases ($p = 0.29$) (figure 1A,B). In endovascular cases, 18 cases were posterior circulation and one case was IC clinoid aneurysms. Of them, ten showed a good recovery and four showed moderate disability.

In endovascular cases, there were nine aged (six were 75 to 79 and three were over 80 years old) cases and GOS were one GR, one MD, five SD, one vegetative state and one death. In surgical cases, there were six aged cases (75 to 79 years old) and GOS were three GR, one SD, one vegetative state and one death. In surgical cases, five out of six were H&H grade I or II, whereas in GDC cases only three out of nine were H&H grade I or II in aged cases.

We performed treatment for the cases of one cardiomyopathy and one renal failure, and both of them presented GR.

Procedure-related complications were seen in six out of 45 endovascular attempted cases include three (6.6%) thromboembolism and three (6.6%) rebleeding during coil introduction. No complications affected morbidity. In our series, failed attempts and changed to surgery were seen in seven (15%) out of a total 45 attempted cases.

Long-term Clinical Results

Long-term clinical follow-ups were performed in 27 of 38 endovascular cases after 14.5 to 58 (mean 33.5) months and in 114 of 142 surgical cases after three to 57 (mean 21.1) months. 77.7% of endovascular and 87.7% of surgical cases showed a favorable outcome ($p = 0.17$) (figure 2).

Cause of death in endovascular cases during long term follow-ups were as follows, two were systemic complications, one was regrowth and rupture of large BA-SCA aneurysm 40 months after treatment, and one was the rupture of large fusiform multiple de novo aneurysms 29 months after the first GDC treatment⁵.

Radiological Follow-up

One of 142 surgical cases clipped for A-com aneurysm showed slipping of the clip resulting in recurrence at early stage. This case was treated by GDC.

In endovascular cases, six out of 27 follow-up cases (22.2%) showed recurrence during the follow-up period (mean 33.5 months) and half of them showed radiologically incomplete occlusion at initial treatments. However, there were three recurrence cases after complete occlusion with sufficient volume embolization rate. Additional GDC treatments were performed on five of them (table 2).

Table 2

	Age	Sex	Location	Size (mm)	Status of initial Treatment	Volume embolization rate (%)	Time to recurrence	Complementary GDC treatment
M.K.	60	F	IC-PC	10	Incomplete body filling	7	2 months	Yes
I.K.	78	F	A-con	8	Incomplete body filling	9,5	3 months	Yes
S.E.	58	F	BA-SCA	8	Neck remnant	15.8	5 months	Yes
K.Y.	55	F	IC-PC	6	Complete	34.1	3 years	Yes
Y.Y.	50	F	MC	6	Complete	35.2	3 months	Yes
H.H.	46	M	VA-PICA	3	Complete	59.7	16 months	No

Discussion

Comparison with Surgical Treatment

There have been several reports concerning the comparison of clinical results between coil embolization and surgical treatment for cerebral aneurysms^{1,2,6,7}. Early non randomized report presented that both treatments showed 60 to 90% of excellent and good outcome cases with statistically non significant differences^{6,7}. In our cases, 71% of total endovascular cases

and 90% of H&H grade I or II cases showed good recovery or moderate disability without procedure related mortality. These results are satisfactory compared to other reports^{6,7}.

Endovascular treatment can approach the poor grade cases less invasively and improve the survival rate⁸, but the rate of good outcome did not change compared to surgical treatment. For grade III cases, surgery may be advantageous because of decompression of haematoma by the comparison with reported surgical results⁹. In our cases, the rate of GR or MD in grade III cases was 50% in GDC and 85% in surgical cases.

The first prospective study of surgical clipping and endovascular treatment in acutely ruptured cerebral aneurysm disclosed that GDC treatment was equal to the result of surgical clipping¹. The ISAT report stated that modified Rankin scale after one year is significantly better in GDC than in surgical cases². Even though these data presented the advantage of endovascular treatment as the first approach for ruptured aneurysm, the need for further follow-up was stressed².

Endovascular Treatment for Surgically Inappropriate Aneurysms

It is reported that endovascular treatment for aneurysms with high surgical risk including posterior circulation and paraclinoid lesions is effective^{17,18,19}. In our cases, 18 cases were posterior circulation aneurysms and one case was carotid cavernous aneurysm. Of them, ten

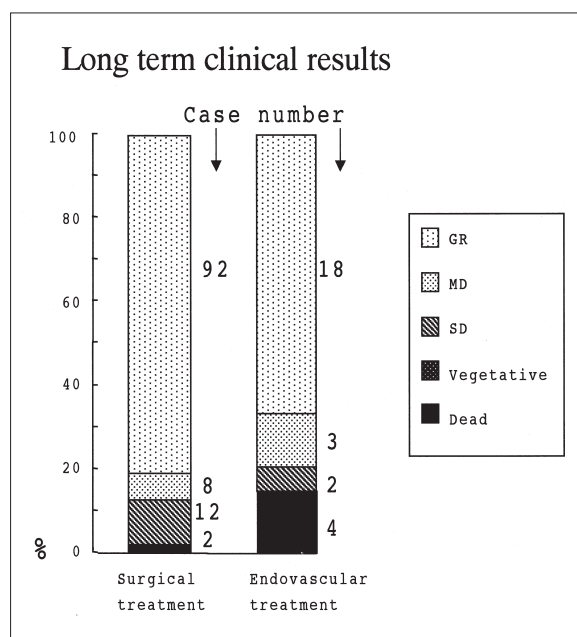


Figure 2

showed good recovery and four showed moderate disability.

Patients with advanced age and high medical risk are now treated endovascularly more frequently than before^{7,8,20}. In our cases, nine were aged (six were 75 to 79 and three were over 80 years old) and of them, one was GR and one was MD at acute stage. However, the result was not good comparing surgery in our series, we selected GDC treatment for poor grade cases which could not be operated and the clinical results were associated with preoperative grade.

Angiographic Recurrence in Endovascular Cases

At present, the reported recanalization rate after endovascular treatment is 15 to 46%¹⁰⁻¹³. A substantial proportion of post-treatment residual aneurysm will have further growth if left without definitive treatment such as surgical clipping or second endovascular coiling¹⁰.

The size of the aneurysm in subarachnoid haemorrhage on angiography may change in size because of elevated intracranial pressure and the existence of a subarachnoid clot^{14,15}. The Doppler ultrasound measurement of ruptured cerebral aneurysm before and after ventricular drainage showed that the size of the aneurysm was small in high intracranial pressure before ventricular drainage¹⁶. The aneurysm can contain a clot at the time of bleeding and the real size of the aneurysm can be temporarily hidden in the case of spasm or large haematoma¹⁴. This fact indicates that the embolized volume is not always correct at the acute stage of ruptured aneurysm.

Unsuccessful Attempt at GDC Treatment

Unsuccessful attempt at GDC treatment is critical for ruptured aneurysm because of the need for immediate hemostasis⁴. From the literature, procedural complications or failed at-

tempts were reported 4.7 to 16.1% with a procedure related mortality of 0 to 7.8%⁴.

The reasons for failed procedure were inability to catheterize (38%), coil extrusion (31%) from the aneurysm and aneurysm perforation (16%)⁴. The risk of aneurysm perforation during GDC treatment was significantly higher in ruptured aneurysms compared with unruptured aneurysms²¹. We also experienced a failed attempt but fortunately our cases showed no morbidity or mortality associated with the procedure.

Conclusions

The short and long term clinical results of GDC treatment were acceptable comparing surgical clipping. However, we have to take into consideration recurrence after GDC treatment which did not permit future completeness of the treatment. The failed attempt at acute stage of ruptured aneurysms will be critical for acutely ruptured aneurysm. The treatment alternative between GDC or surgical clipping for ruptured aneurysm may change depending on the technique and experience of each institution, and attention should be paid to the disadvantages of endovascular treatment as the first choice for ruptured aneurysms.

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